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## NEW CANADIAN SPECIES OF LEAF-MINING LEPIDOPTERA OF CONIFERS

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INVESTIGATION OF LEAF-MINING LEPIDOPTERA on conifers, conducted by myself and several officers of the Canada Department of Forestry, have revealed the presence of several new species. These are described here as a preface to subsequent papers dealing with their life histories in more detail than the characteristic behaviour of some immature stages included in these descriptions. All the species of the genus *Pulicalvaria* Freeman have almost identical genitalia but may be recognized by the habits of the immature stages, and to a lesser extent by differences in maculation. The genus is well characterized by its peculiar male and female genitalia (Figs. 1, 2). As far as is known, it is restricted to coniferous trees in North America, and each species is restricted to a single plant species or to closely allied species within a plant genus.

This paper deals with six undescribed species of the gelechiid genus *Pulicalvaria* Freeman, one of the gelechiid genus *Eucordylea* Dietz, and one of the tortricid genus *Epinotia* Hubner.

### GELECHIIDAE

***Pulicalvaria martini* Freeman, new species**

Figs. 1, 2, 3

GENERAL. — Antenna with black and ochreous-white bands. Second joint of palpus with white inwardly, and with two patches of black and ochreous scales outwardly; terminal joint white, with a subbasal and subapical black band. Head shining ivory white, sometimes slightly ochreous on vertex. Thorax ochreous with two minute, anterior black dots and a minute posterior one on scutellum. Forewing shining black, with fawn-coloured scales below fold extending from base to near middle of trailing mar-

gin; a slightly outwardly oblique white fascia at costal third extending to fold; a white, median costal spot; an outwardly-angled, transverse white fascia at outer fourth; apical fringe grey, speckled with black, apical scales white-tipped; trailing fringe leaden grey. Hind wing black; fringe leaden grey. Male with pale-ochreous hair-pencil extending from beneath base of hind wing (Fig. 1). Legs black, banded with white; hind tibia and tarsus pale ochreous inwardly. Wingspread 9-10 mm. Moth in late May and early June.

MALE GENITALIA (Fig. 2). — Uncus subspherical, with long, lateral coarse hairs directed anteriorly; gnathos with median, pendulous hook-like process, and two lateral flange-like processes; tegumen elongate, truncate apically, without lateral lobes; claspers long, tubular and twisted, the left one aborted; aedeagus short, arcuate, and membranous; vinculum produced apically into two tapering sicae, and with a lobate protrusion on right side.

FEMALE GENITALIA (Fig. 3). — Ovipositor lobes membranous; posterior apophyses very long and thin; anterior apophyses much shorter and stouter; ventral plate extended anteriorly into a pair of short processes; ductus bursae short, containing a small sclerotized plate near the ostium; signum spinose, conical.

HOLOTYPE. — Male, Ancaster, Ontario, 23 June 1961 (Freeman and Lewis). Reared from *Picea abies* (L.) Karst. No. 7780 in the Canadian National Collection, Ottawa, Ontario. *Paratypes*. — Ninety males, 107 females, Ancaster, Ontario, 19 May — 2 June 1961 (Freeman and Lewis). Reared from *P. abies*.

DISTRIBUTION. — Known only from Ancaster and Simcoe, Ont.; Hull, Que.; and Bar Harbor, Me.

FOOD PLANTS. — *Picea abies* (L.) Karst. (Ont. rearings); and *P. glauca* (Moench.) Voss. (Que. and Maine rearings).

BEHAVIOUR. — The first-instar larva mines from the tip of the leaf down one side about one-quarter the length. The second-instar larva enters the tip of another leaf and mines downward to about one-half or two-thirds of the length of the leaf. Most of the frass is ejected from these mines. The larva leaves this leaf, enters another near the base, and mines almost to the tip. A silk tube or tent is constructed at the mine entrance and the frass is deposited on, and adheres to the silk. As additional leaves are mined from the base, the silk tent is continued along the twig to each new mine entrance, and the frass continues to be placed on the silk. The larva overwinters beneath the frass-covered tent. It continues mining in the same manner in the spring. The



Fig. 1, dorsal view of head, thorax and hair-pencils of *Pulicalvaria martini*. Figs. 2, male; 3, female genitalia of *P. martini*. Figs. 4, male; 5, female genitalia of *Eucordylea albicostata*. Fig. 6, male genitalia of *Epinotia balsameae*.

larvae occur on young trees in shady locations. In the laboratory, pupation occurred within the frass-covered tube.

REMARKS. — The black forewing, with the fawn-coloured area behind the fold, resembles *P. laricis* new species. (See below). However, the smaller size of *martini* and the characteristic larval behaviour distinguish this species from *laricis*. The larva of *martini* has reddish, transverse abdominal bands. The head and prothorax are light amber. This species is named in honour of the original collector Mr. J. E. H. Martin, Entomology Research Institute, Canada Department of Agriculture, Ottawa.

***Pulicalvaria granti* Freeman, new species**

GENERAL. — Antenna alternately marked with black and ochreous bands. Palpus white. Face and vertex shining white. Forewing white, sprinkled with light ochreous-tipped scales; basal fifth of costa black, the black colour sometimes extending obliquely outward to fold, or broken into blackish spots; just beyond middle of costa, a broad black band extending obliquely outward to fold, and continuing narrowly along fold, there joining a similar band at outer quarter; near trailing margin two small black spots, almost opposite the two black bands; outer black band margined outwardly with white scales; apical portion of wing with small black dots along costal and trailing margins; fringe light grey. Hind wing and fringe light grey. Male with a light-ochreous hair-pencil extending from beneath base of hind wing. Legs white; hind tibia and tarsus with strikingly black bands. Wingspread 9.0-9.5 mm. Female with markings as in male, but with more ochreous ground colour. Moth in early July.

GENITALIA. — Similar to those of *P. martini*.

HOLOTYPE. — Male, Boswell, British Columbia, 29 June 1960. Reared from *Abies grandis* (Dougl.) Lindl. (Forest Insect Survey rearing). No. 7973 in the Canadian National Collection, Ottawa, Ontario. PARATYPES. — Two males, one female, Boswell, B. C., 29-30 June 1960. Two males, West Creston, B. C., 2 and 8 July 1959. All reared from *Abies grandis*.

DISTRIBUTION. — Known only from southeastern British Columbia.

FOOD PLANT. — *Abies grandis* (Dougl.) Lindl.

BEHAVIOUR. — The larva enters a leaf from the undersurface, often near the apex, or between the apex and the middle. Usually there is only one hole in each leaf, and all frass is ejected. The larva overwinters in a leaf, and resumes mining the previous year's growth in the spring. Several leaves are mined and loosely

tied together with silken strands. A favorite mining location is where the leaves of adjacent twigs overlap.

REMARKS. — This species closely resembles the eastern spruce feeder *P. piceaella* (Kft.), but may be distinguished from it by the more pronounced black bands in the forewing and the larval habits. It is named in honour of Mr. James Grant, Division of Forest Insects, Vernon, B. C., who collected the specimens.

***Pulicalvaria macleodi* Freeman, new species**

GENERAL. — Antenna alternately marked with ochreous and brown bands. Palpus light ochreous, second joint with basal and subapical brownish spots; apical joint with a brownish sub-basal band and a black subapical ring. Face and vertex shining whitish. Thorax and ground colour of forewing ochreous white. Forewing with an oblique black streak, extending from base of costa to just beyond fold, terminating in a small patch of raised scales; just before middle, another transverse black band extending less obliquely to middle of wing; opposite this, and just below fold, another small black spot of raised scales; on costa at outer third a rather broad, blackish transverse band narrowly bordered with white apically, and continuing across wing to form a V; around apex of wing are five or six small black dots; apical fringe grey, trailing fringe somewhat lighter. Hind wing and fringe light grey. Fore- and mid-legs with black and cream bands. Hind legs cream, with some black bands on tarsi. Wingspread 9-11 mm. Male with an ochreous hair-pencil arising from beneath base of hind wing. Moth in late May and early June.

GENITALIA. — Similar to those of *P. martini*.

HOLOTYPE. — Male, Twin Elm, Ontario, 26 May 1961 (Freeman and Lewis). Reared from *Tsuga canadensis* (L.) Carr. No. 7972 in the Canadian National Collection, Ottawa, Ont. PARATYPES. — Six males, one female, Twin Elm, Ont., 23-26 May 1961 (Freeman and Lewis). Two males, one female, Prescott, Ont., 26 May-12 June 1961 (Freeman and Lewis). Two males, two females, South March, Ont., 21 May-13 June 1961 (Freeman and Lewis). Five males, two females, Normandale, Ont., 16-23 May 1961 (Freeman and Lewis). All reared from *Tsuga canadensis*.

DISTRIBUTION. — Known only from southern Quebec and southern Ontario.

FOOD PLANT. — *Tsuga canadensis* (L.) Carr.

BEHAVIOUR. — The larva at first mines one or two leaves, entering near the base. It overwinters in a mine and resumes feeding in the spring. Six or more leaves, sometimes from overlapping

branchlets, are mined and tied loosely together. An elongate silk tube is constructed on the underside of the branchlet joining the bases of the mined leaves, and all frass is ejected from the mines. As the larva approaches maturity it hollows out the leaves from the undersurface, apparently being too large to mine the very thin hemlock leaves. Pupation occurs in the silk tube in late May. This behaviour is similar to that of the *Tsuga* feeding sympatric species *P. abietisella* (Pack.). Rather limited observations show that *macleodi* overwinters in a later instar than *abietisella*, and is therefore, larger at that time. In consequence, a few more leaves are mined before winter.

REMARKS. — The adults are much less ochreous than those of *abietisella*. The larva is reddish brown, not green as is that of *abietisella*. This species is named in honour of Dr. J. M. McLeod, Department of Forestry, Sillery, Quebec. Dr. McLeod was the first to observe that in Quebec material two differently coloured larvae were present on *Tsuga*.

The specific names *attritella* Walker (1864, Cat. Lep. Het. Brit. Mus.) and *abietisella* Packard (1884, Rept. U. S. Dept. Agri. p. 150) have for some years been placed in the synonymy of *Recurvaria apicitripunctella* Clemens (1860, Proc. Acad. Nat. Sci. Phila. p. 165). I have examined a coloured photograph of Walker's female type in the British Museum, London, and one of Clemens' type in the Academy of Natural Sciences, Philadelphia. These specimens are undoubtedly allied to the two species mentioned above, but they do not quite match them in maculation. Neither Clemens nor Walker made any mention of the food plant, and Clemens didn't even state the locality, although his type might have been collected in Pennsylvania or in Virginia. I cannot apply *attritella* or *apicitripunctella* with certainty to any of the species. I am familiar with. Therefore, I am using Packard's name. His description fits exactly the species that has a green larva.

#### ***Pulicalvaria laricis* Freeman, new species**

GENERAL. — Antenna alternately marked with black and ochreous bands. Second joint of palpus white, with two black spots outwardly, one near base, the other near apex abutting on a small patch of fawn-coloured scales; terminal joint black with white apex and a white band near middle. Face and vertex shiny white. Thorax of male light fawn with shiny black scales at bases of tegulae; of female mottled light grey and black. Forewing shiny black, interspersed with fawn-coloured scales, particularly in anal half of wing, and along two-thirds of trailing

margin; an outwardly oblique white fascia at basal quarter extending from costa to just beyond fold; another outwardly oblique white fascia extending from middle of costa almost to trailing margin; another outwardly angled, white, transverse fascia at apical quarter; beyond this, tips of scales fawn coloured; six or seven small black dots extending around apical margin; a raised black-and-white scale patch at basal quarter in fold; a pair of black-and-white submedian patches, and another similarly coloured pair at outer third; apical fringe fuscous, with tips of some scales fawn coloured; posterior fringe silvery grey. Hind wing light grey; fringe silvery grey. Male with a long, light-ochreous hair-pencil extending from beneath base of hind wing. Fore- and mid-femur and tibia black with whitish patches; hind femur cream coloured, with black patches outwardly; tarsus with black and whitish bands. Wingspread 10.5-13 mm. Moth in July.

GENITALIA. — Similar to those of *P. martini*

HOLOTYPE. — Male, Ottawa, Ontario, 27 May 1960 (Freeman and Lewis). Reared from *Larix laricina* (Du Roi) K. Koch. No. 7977 in the Canadian National Collection, Ottawa, Ont.

PARATYPES. — Four males, three females, Ottawa, Ont., 16 May - 7 June 1960 (Freeman and Lewis). One male, Pleasant Harbour, Ont., 27 July 1951, F. I. S. 051-1409A. One female, Stittsville, Ont., 24 July 1939 (G. A. Hobbs). All reared from *Larix laricina*.

DISTRIBUTION. — Known only from the above localities in Ontario.

FOOD PLANT. — *Larix laricina* (Du Roi) K. Koch.

BEHAVIOUR. — The larva starts mining in mid-summer from the base of the leaf. One or two leaves are partly mined, and some frass is left in the mine. In the fall a few leaves are tied with silk horizontally along the twig, where most of the frass has accumulated, and the larva hibernates under these leaves. In the spring the larva ties some young leaves into a bundle, and feeds on the apical portions in much the manner as *Argyrotaenia pinatubana* (Kft.). It may pupate in this bundle or form a new one nearby for pupation.

REMARKS. — The adult maculation resembles that of the *Picea*-feeding *P. martini*, but the moth of *laricis* is larger and has a median white fascia. In *martini* this is reduced to a white costal spot.

#### **Pulicalvaria carbonaria** Freeman, new species

GENERAL. — Antenna with alternate black and white bands. Palpus with second joint white; apical joint white, with a sub-apical and a sub-basal black band. Face white. Vertex with

grey, black-tipped scales. Legs with alternate black and white bands. Forewing black, with white oblique fasciae and ochreous scales; basal fourth black, particularly on costa, lighter at trailing margin, and with a black spot of raised scales below fold; beyond basal patch an outwardly-oblique white fascia, bordered outwardly with brownish-ochreous scales, particularly on trailing margin; a short, median, outwardly-oblique white costal streak, bordered outwardly with brownish scales; at apical fourth an outwardly angled, transverse white fascia, followed by brownish-ochreous scales; between outer fascia and basal patch below fold, three almost equidistant black spots; apical fourth with submarginal black dots; apical fringe fuscous, with black scales basally, and with white-tipped scales apically; fringe of trailing margin shiny fuscous. Hind wing fuscous; fringe shiny fuscous. Abdomen black. Male without a hair-pencil beneath base of hind wing. Wingspread 7.5-10.0 mm. Moth in early June.

**MALE GENITALIA.** — Similar to those of *P. martini*, but with the lobate protrusion on right side of vinculum usually less developed.

**FEMALE GENITALIA.** — Similar to those of *P. martini*.

**HOLOTYPE.** — Male, Simcoe, Ontario, 1 June 1960 (Freeman and Lewis). Reared from an ornamental *Juniperus* sp. No. 7975 in the Canadian National Collection, Ottawa, Ontario. **PARATYPES.** — Seventeen males and 21 females, Simcoe, Ont. (Freeman and Lewis) 31 May - 15 June 1960. Fourteen males and 17 females, Simcoe, Ont. (T. N. Freeman) 29 May - 22 June 1955. All reared from the above *Juniperus* sp.

**DISTRIBUTION.** — Known only from Simcoe, Ont.

**BEHAVIOUR.** — The larva starts mining the terminal leaves and the stem in late summer, leaving frass in the mines. It mines from the tip of the branchlet toward the base, and overwinters in the stem or in mined leaves. In the spring the larva continues mining the stem, and hollows out the leaves from the inside. The frass is left in the leaves, along and in the stem. Pupation occurs in late May in a short, frass-covered silk tube on the twig, at the base of the damaged leaves.

**REMARKS.** — This species somewhat resembles the *Picea*-feeding *P. martini*, but lacks the ochreous shading below the fold and the male hair-pencils.

#### ***Pulicalvaria occidentis* Freeman, new species**

**GENERAL.** — Antenna alternately marked with white and dark-brown bands. Second joint of palpus white, outwardly marked with a basal and a subterminal brown patch; terminal



joint white with a sub-basal and a subterminal brown band. Face, vertex, and thorax shining white. Forewing white, with ochreous scales scattered in outer three-quarters; costa black from base to an oblique, black fascia at the basal fifth, this extending to just beyond fold; a submedian black streak extending obliquely outward to middle of wing, and terminating below a black costal spot at apical third; an elongate, subapical black patch borders on a round, apical white patch containing a small, central black spot; apical fringe mottled with fuscous and white; trailing fringe greyish. Hind wing and fringe grey. Hair-pencil at base of hind wing absent. Legs with black and white bands. Wingspread 9-11 mm. Moth in late June and early July.

GENITALIA. — Similar to those of *P. martini*.

HOLOTYPE. — Male, Ta Ta Creek, British Columbia, 18 June 1958 (Freeman and Lewis). Reared from *Juniperus scopulorum* Sarg. No. 7974 in the Canadian National Collection, Ottawa, Ontario. PARATYPES. — Seven males, 33 females, Invermere, B. C., 26-30 June 1957. One female, Ta Ta Creek, B. C., 20 June 1958. One female, Dutch Creek, B. C., 22 June 1958. Paratypes reared from *J. scopulorum*.

DISTRIBUTION. — Known only from the above localities in southeastern British Columbia.

FOOD PLANT. — *Juniperus scopulorum* Sarg.

BEHAVIOUR. — The larva starts mining in the summer from the tip of a branchlet toward the base, mining very thoroughly both the leaves and the stem. All frass is ejected from the mine. The larva overwinters in the mine, and continues mining toward the base in the spring. Pupation occurs in the mine in early June, the pupa facing toward a large round exit-hole. A short silk ramp is usually made within the mine, and leads to the exit.

REMARKS. — The maculation resembles that of the eastern *Thuja*-feeding *thujaella* (Kft.), but *occidentis* is paler.

***Eucordylea albicostata*** Freeman, new species

Figs. 4, 5

*Recurvaria obliquistrigella*: Kearfott, 1903, J. New York ent. Soc. 11: 152, Pl. 9, fig. 2.

GENERAL. — Antenna with alternate black and whitish bands. Palpus with second joint whitish inwardly, black outwardly; apical joint white with black apex and sub-basal black band. Head and thorax smooth; shining ivory-white. Abdomen of male ochreous above; of female shiny leaden coloured. Forewing ochreous-white, with a broad, black longitudinal streak extending from base through center of wing almost to apex; this streak

straight along its anterior margin, somewhat wavy or irregular along its posterior margin; just before middle of costa, a short, black, outwardly-oblique streak; beyond middle a broader, longer, outwardly-oblique, black streak, tapering from costa and extending almost to black longitudinal streak; apical third of wing ochreous-white with scattered small black spots; apical fringe scales speckled with ochreous, grey, and black; fringe of trailing margin shiny grey. Hind wing dirty white with shiny, slightly ochreous fringe. Legs black with ochreous patches and bands. Male with a large ochreous hair-pencil arising from beneath base of hind wing. Wingspread 9-10 mm. Moth in first half of June.

MALE GENITALIA (Fig. 4). — Uncus roof-like; shallowly bilobed apically. Gnathos with a long, pendulous, median hook, and two lateral, elongated processes. Tegumen with two lateral projections, the left one much larger, curved and tapering. Claspers asymmetrical, tubular and tapering; the right one larger, twisted, and with a much recurved apex. Sicae slightly sinuous. Aedeagus large, tubular, and arcuate.

FEMALE GENITALIA (Fig. 5). — In general similar to those of *P. martini*, but with signum cruciform with serrate edges, and with lateral edges folded inwardly.

HOLOTYPE. — Male, Simcoe, Ontario, 6 June 1959 (Freeman and Lewis). Reared from *Juniperus virginiana* L. No. 7970 in the Canadian National Collection, Ottawa, Ontario. PARATYPES. — Three males, seven females 7-21 June 1959. Four males, four females, 13-20 June 1960. All from the same locality and food plant as the holotype.

DISTRIBUTION. — Known only from the type locality and New Jersey. See remarks below.

FOOD PLANT. — *Juniperus virginiana* L.

BEHAVIOUR. — The larva mines in the scale-like leaves, starting at or near the base of a branchlet and mining toward the tip. It overwinters in the mine, and continues feeding in the spring. The mined branchlets are loosely tied together, and most of the frass is ejected from the mine entrance. Occasionally some frass is deposited at the tip of a mined branchlet. When full grown, about the end of May, the larva constructs a frass-covered silk ball between the branchlets or in the apex of a mined branchlet, where it pupates.

REMARKS. — This is the species figured by Kearfott as *obliquistrigella* Chamb. I have examined Chambers' type in the Museum of Comparative Zoology, Cambridge, Mass. It

agrees with Chambers' original description (1872, *Canad. Ent.* 4: 65) and is decidedly unlike the specimen figured by Kearfott from New Jersey.

### TORTRICIDAE

#### *Epinotia balsameae* Freeman, new species

##### Fig. 6

**GENERAL.** — Antenna pale grey. Face and vertex ochreous white. Patagium light grey. Abdomen brown, semi-lustrous, apex white. Forewing dark brown with whitish, geminate costal spots and transverse striae. Costal geminations broadest just before middle and continuing rather faintly across wing directly to trailing margin; about middle of wing the inner pair of fasciae expanding into a patch of white scales; at outer third a pair of white costal geminations, continuing faintly and somewhat obliquely to a faint ocelloid patch near tornus; this patch with some silvery-white scales arranged in one to three short striae; near apex a pair of white, short, costal streaks; fringe shining, leaden fuscous. Hind wing semi-lustrous, leaden brown; fringe greyish brown. Legs semi-lustrous, whitish. Wingspread 7-8 mm. Moth in late May and early June.

**MALE GENITALIA** (Fig. 6). — Uncus bifurcate. Socii well developed. Clasper broad throughout, scimitar-shaped; sacculus with a cluster of short, stout, spines. Aedeagus straight, stout; cornuti a cluster of elongate spines.

**HOLOTYPE.** — Male, Aylmer, Quebec, 19 May 1961 (G. G. Lewis). No. 8457 in the Canadian National Collection, Ottawa. **PARATYPES.** — Two males, Stittsville, Ontario, 27 May 1958 (Freeman and Lewis) and 7 June 1959 (Freeman and Lewis). All three specimens reared from *Abies balsamea* (L.) Mill.

**DISTRIBUTION.** — Known only from the above localities which are near Ottawa, Ontario.

**FOOD PLANT.** — *Abies balsamea* (L.) Mill.

**BEHAVIOUR.** — The young larva overwinters in a mine and resumes mining in the spring. Four to six leaves are mined, usually in pairs, each leaf mined from near the base to the apex. Each pair of mined leaves usually has a loose silk tube connecting the mine entrances. After mining one leaf and ejecting all frass, the larva enters an adjacent leaf and then backs through the silk tube into the first mined leaf to deposit frass near the apex of the leaf formerly mined. Pupation occurs in early May in the mine, the pupa facing the mine entrance, or sometimes partially protruding from it.

REMARKS. — On the basis of the male genitalia, this species is closely allied to *Epinotia normanana* Kft. and *E. aridos* Free. *E. balsameae* is darker than the other two species, and is smaller than *aridos*, which has a wingspread of 11 mm., and not 6 mm. as printed in error in the original description (1960, Canad. Ent. Suppl. 16: 30).